

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
Use of Spectrum Bands Above 24 GHz For)	GN Docket No. 14-177
Mobile Radio Services)	
)	
Establishing a More Flexible Framework to)	IB Docket No. 15-256
Facilitate Satellite Operations in the 27.5-28.35)	
GHz and 37.5-40 GHz Bands)	
)	
Petition for Rulemaking of the Fixed Wireless)	RM-11664
Communications Coalition to Create Service)	
Rules for the 42-43.5 GHz Band)	
)	
Amendment of Parts 1, 22, 24, 27, 74, 80, 90, 95,)	WT Docket No. 10-112
and 101 To Establish Uniform License Renewal,)	
Discontinuance of Operation, and Geographic)	
Partitioning and Spectrum Disaggregation Rules)	
and Policies for Certain Wireless Radio Services)	
)	
Allocation and Designation of Spectrum for)	IB Docket No. 97-95
Fixed-Satellite Services in the 37.5-38.5 GHz,)	
40.5-41.5 GHz and 48.2-50.2 GHz Frequency)	
Bands; Allocation of Spectrum to Upgrade Fixed)	
and Mobile Allocations in the 40.5-42.5 GHz)	
Frequency Band; Allocation of Spectrum in the)	
46.9-47.0 GHz Frequency Band for Wireless)	
Services; and Allocation of Spectrum in the 37.0-)	
38.0 GHz and 40.0-40.5 GHz for Government)	
Operations)	

COMMENTS OF WI-FI ALLIANCE

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COMMENTS OF WI-FI ALLIANCE

Wi-Fi Alliance®^{1/} submits these comments in the above-referenced proceeding in which the Commission seeks further comment on the technical rules governing the millimeter wave

^{1/} Wi-Fi®, the Wi-Fi logo, the Wi-Fi CERTIFIED logo, Wi-Fi Protected Access® (WPA), WiGig®, the Wi-Fi ZONE logo, the Wi-Fi Protected Setup logo, Wi-Fi Direct®, Wi-Fi Alliance®, WMM®, and Miracast® are registered trademarks of Wi-Fi Alliance. Wi-Fi CERTIFIED™, Wi-Fi Protected Setup™, Wi-Fi Multimedia™, WPA2™, Wi-Fi CERTIFIED Passpoint™, Passpoint™, Wi-Fi CERTIFIED Miracast™, Wi-Fi ZONE™, WiGig CERTIFIED™, Wi-Fi Aware™, Wi-Fi HaLow™, the Wi-Fi Alliance logo and the WiGig CERTIFIED logo are trademarks of Wi-Fi Alliance.

bands it has already made available for mobile wireless operations and on its proposals to make additional millimeter wave spectrum available. Wi-Fi Alliance commends the Commission's actions to date in this proceeding which designated an additional 7 gigahertz of high-band spectrum for unlicensed use. As the Commission continues to explore the potential of other millimeter wave bands, Wi-Fi Alliance urges the Commission to ensure that there is sufficient unlicensed spectrum capacity to enable new and different kinds of applications, and to ensure that rules governing newly designated unlicensed spectrum enable the greatest range of innovation.

I. INTRODUCTION AND SUMMARY

Wi-Fi Alliance is a global, non-profit industry association of over 700 leading companies from dozens of countries devoted to seamless connectivity. With technology development, market building, and regulatory programs, Wi-Fi Alliance has enabled widespread adoption of Wi-Fi® worldwide, certifying thousands of Wi-Fi products each year. The mission of Wi-Fi Alliance is to provide a highly effective collaboration forum, grow the Wi-Fi industry, lead industry growth with new technology specifications and programs, support industry-agreed standards, and deliver greater product connectivity through interoperability, testing, and certification.

Wi-Fi Alliance is grateful for the work that the Commission has done so far in this proceeding to make spectrum in the millimeter wave bands available on an unlicensed basis. In extending the unlicensed 57-64 GHz band, the Commission recognized that “unlicensed WiGig devices . . . are just beginning to be marketed” and that the newly available spectrum would “enable higher throughputs and enhanced usage of present spectrum, as well as . . . permit an

increase in the number of simultaneous high-bandwidth users.”^{2/} As Wi-Fi Alliance reminded the Commission in this proceeding,^{3/} Wi-Fi is a critical component of the wireless ecosystem supporting, among other things, the majority of Internet access today with a wide array of applications, including the Internet of Things. In particular, the ubiquity and economic impact of Wi-Fi will be extended as WiGig® technologies continue to be implemented in the millimeter wave bands.

The next phase of this proceeding will build on the important decisions the Commission has already made. As the Commission proceeds, it should designate additional spectrum for unlicensed use — using a range of available regulatory tools — between 24 GHz and 57 GHz, as well as above 95 GHz. Making spectrum within those ranges available for unlicensed use would encourage the development of innovative applications in the same way that opening up the 2.4 GHz band for unlicensed use enabled the initial development of Wi-Fi. However, the Commission should continue its current successful approach to authorizing use of the 70/80 GHz bands. In developing rules that will govern already-allocated spectrum, the Commission should fully permit unlicensed operations in the 37.0-37.6 GHz (“Lower 37 GHz”) band and authorize unlicensed use of the 57-71 GHz band on board aircraft.

II. THE COMMISSION SHOULD DESIGNATE ADDITIONAL SPECTRUM FOR UNLICENSED USE BETWEEN 24 GHz AND 57 GHz

“Tak[ing] steps to ensure that additional spectrum is available to allow the next generation of wireless technologies to flourish”^{4/} and recognizing that “the amount of global data

^{2/} *Use of Spectrum Bands Above 24 GHz, et al.*, Report and Order and Further Notice of Proposed Rulemaking, 31 FCC Rcd. 8014, ¶ 130 (2016) (“Report and Order” or “Further Notice,” as appropriate).

^{3/} *See* Comments of Wi-Fi Alliance, GN Docket No. 14-177, *et al.*, at 2-4 (filed Jan. 27, 2016).

^{4/} Further Notice ¶ 369.

traffic will continue to grow exponentially,”^{5/} the Commission proposes multiple additional millimeter wave bands in which mobile operations may be permitted, generally on a licensed basis.^{6/} Wi-Fi Alliance urges the Commission to designate some of that additional spectrum between 24 GHz and 57 GHz for unlicensed use.

Today, there is a wide gulf between the bands available for unlicensed use. On the one hand, there is, and will continue to be, heavy use of the 2.4 GHz and 5 GHz bands, currently the workhorses that support most unlicensed applications. More than half of the 12 billion Wi-Fi products shipped to-date are dual-band Wi-Fi devices operating in both the 2.4 GHz and 5 GHz bands.^{7/} Wi-Fi has an installed base of more than 6.8 billion devices, and by the end of 2019, there is expected to be more than 10 billion devices in households worldwide.^{8/} On the other hand, uses for the 57-71 GHz band, including WiGig applications, continue to grow and the Commission’s designation of the 64-71 GHz band will further spur development in those bands. International standards organizations are actively developing use cases for the next generation of WiGig, such as the mobile use of high-end augmented or virtual reality headsets and other wearables, backup inter-rack connectivity for data centers, and mass video or data distribution to devices in classrooms, exhibition halls, or airplane or train cabins.^{9/} However, there is no unlicensed spectrum within the 33 gigahertz between 24 GHz and 57 GHz, where the Commission is considering additional 5G allocations.

^{5/} *Id.* ¶ 372.

^{6/} *See id.* ¶¶ 370-378.

^{7/} *See Wi-Fi Device Shipments to Surpass 15 Billion by End of 2016*, WI-FI ALLIANCE NEWSROOM (Jan. 5, 2016), <http://www.wi-fi.org/news-events/newsroom/wi-fi-device-shipments-to-surpass-15-billion-by-end-of-2016>.

^{8/} *Id.*

^{9/} *See IEEE 802.11 TGay Use Cases* (IEEE 802.11-2015/0625r3), at 7-12 (Sept. 2015), *available at* <https://mentor.ieee.org/802.11/dcn/15/11-15-0625-03-00ay-ieee-802-11-tgay-usage-scenarios.pptx>.

Chairman Wheeler recently recognized the importance of making available low, mid, and high-band spectrum for wireless carriers.^{10/} Just as spectrum in a variety of bands is important for licensed operations, so too is it critical to support unlicensed devices; licensed and unlicensed spectrum serve complementary uses.^{11/} Spectrum between 24 GHz and 57 GHz, can be used for applications that are not as well suited for existing unlicensed bands. Among other things, they have better building penetration characteristics than the 57-71 GHz band, but are also capable of higher bandwidths and throughput than in the 2.4 GHz and 5 GHz bands.

In making additional spectrum available for unlicensed devices, the Commission should, where feasible, follow the pattern established by Wi-Fi, which uses device-centric contention mechanisms. In other words, Wi-Fi devices themselves work together to avoid causing harmful interference to each other. That approach has also been successfully employed even when there are other services sharing spectrum with Wi-Fi. For example, device-centric spectrum sharing technologies such as dynamic frequency selection have been successful in circumstances requiring protection of primary operations by secondary unlicensed uses.

Where such device-based contention protocols are available, the Commission need not mandate the use of a third-party database, such as a Spectrum Access System (“SAS”), to coordinate devices in whatever additional spectrum it designates for unlicensed use. That approach may be appropriate under certain circumstances — for instance, to assign rights among or between different classes of users (*e.g.*, licensed and unlicensed users) — but need not be

^{10/} See Tom Wheeler, Remarks of FCC Chairman Tom Wheeler, CTIA Mobility Show 2016, Las Vegas, at 3 (Sept. 7, 2016), *available at* <https://www.fcc.gov/document/fcc-chairman-wheeler-ctia-super-mobility-show-2016-las-vegas> (“[T]he FCC has opened the door to the spectrum trifecta. We’ve targeted low-band, mid-band, and high-band airwaves that make available unprecedented amounts of spectrum.”).

^{11/} For example, “Wi-Fi helps to offload 3G/4G mobile Internet users to Wi-Fi networks, which is a more cost-effective method for both mobile carriers and mobile users.” ABI Research News Release, *Global Wi-Fi Hotspots Will Grow to 7.1 Million in 2015 as a Method to Offload Traffic* (May 8, 2014), <https://www.abiresearch.com/press/global-wi-fi-hotspots-will-grow-to-71-million-in-2>.

employed when spectrum is allocated solely or principally for unlicensed use. A device-based approach will promote more robust use of unlicensed spectrum, rather than the more burdensome top-down regulatory management of spectrum or dynamic management of spectrum by an external SAS.

The spectrum used by Wi-Fi today —generally in the 2.4 GHz and 5 GHz bands —is licensed under Part 15 of the Commission’s rules. However, the Commission has permitted device use without a license under other provisions of its regulations. For example, the Commission permits spectrum use through a “license-by-rule” approach and General Authorized Access use of the 3.5 GHz band.^{12/} While the Part 15 model has produced exciting new technologies and is preferred when available, the Commission should consider all methods of making spectrum available without authorizations. Conversely, in making additional spectrum available in the millimeter wave bands, the Commission should ensure that all radio access technologies —including Wi-Fi —can use the spectrum. While Wi-Fi has enjoyed its greatest success to date in spectrum designated for unlicensed operations, there is no reason why it cannot also be used by licensees in licensed spectrum.

III. THE COMMISSION SHOULD CONTINUE ITS CURRENT APPROACH TO AUTHORIZING USE OF THE 70/80 GHz BANDS

The Commission proposes a three-tier framework, involving a 3.5 GHz band-style SAS, to manage use of the 70/80 GHz bands.^{13/} Wi-Fi Alliance opposes this proposal; the Commission should instead continue with its current approach, *i.e.*, a dual-authorization approach requiring users to hold a non-exclusive, nationwide authorization and site-based registrations for individual, point-to-point links.

^{12/} See, 47 C.F.R. §§ 95.1 *et seq.*, 47 C.F.R. §§ 96.1 *et seq.*

^{13/} See Further Notice ¶ 440.

As noted above, making more spectrum for unlicensed use through device-based contention is generally preferable. However, as the Commission recognizes, there is already extensive use of the 70/80 GHz bands. The Commission observes that there are 446 active non-exclusive, nationwide licensees in the 70 GHz, 80 GHz, and 90 GHz bands, and there are approximately 22,600 registered fixed links in the 70/80 GHz bands.^{14/} In this intensively used spectrum, device-based contention would be difficult to introduce, and the FCC’s current approach has clearly worked well.

Further, federal incumbents in the 70/80 GHz bands are currently protected through a system involving a third-party database, which coordinates with the National Telecommunications and Information Administration’s automated “green light/yellow light” mechanism to determine the potential for harmful interference to federal users. There is no reason to layer additional, cumbersome management of spectrum on top of that. In any case, as the Commission has recognized, use of the 70/80 GHz bands typically involves “pencil beam,” high-frequency beamforming, which permits the spectrum to be reused through coordination without requiring real-time protection from interference.^{15/} The Commission need not revisit its earlier conclusion that the bands’ technical characteristics do not require more involved management of the spectrum.

IV. THE COMMISSION SHOULD MAKE AMPLE SPECTRUM ABOVE 95 GHz AVAILABLE FOR UNLICENSED USE

The Commission asks whether there are particular bands above 95 GHz that should be designated for unlicensed operations at this time.^{16/} It is premature to identify particular bands above 95 GHz that should be designated for use by unlicensed devices. However, when the

^{14/} *Id.* ¶ 425.

^{15/} *Id.* ¶ 424.

^{16/} *Id.* ¶¶ 442-445.

Commission targets particular segments of the bands above 95 GHz for future use, it should ensure that ample spectrum in those bands should be available for unlicensed uses.

Just as there should be spectrum for unlicensed use in the bands currently being evaluated between 24 and 71 GHz, so too should there be spectrum above 95 GHz available for unlicensed devices. Spectrum above 95 GHz will satisfy different requirements than current and projected unlicensed spectrum below 95 GHz. As in the 70/80 GHz bands, the propagation characteristics of bands above 95 GHz require focused antenna beamforming, so that many different devices can operate in close proximity without causing any harmful interference to each other — making unlicensed use of this spectrum particularly attractive. Although it is yet unclear what sort of applications may become prevalent in the bands above 95 GHz, it remains important to create an environment for developers to experiment with and create new, innovative applications that may replicate the success of Wi-Fi in the 2.4 GHz and 5 GHz bands.

V. THE LOWER 37 GHz BAND SHOULD BE COMPLETELY UNLICENSED

In the Report and Order, the Commission designated the Lower 37 GHz band for shared federal/non-federal use,^{17/} and in the Further Notice it seeks comment on the most appropriate coordination mechanism for facilitating federal and non-federal access to the band.^{18/} This spectrum should be completely unlicensed, as with the 64-71 GHz band.

The Commission should not encumber the band with complicated access mechanisms, but allow device-based contention mechanisms, as in other bands designated for unlicensed spectrum. Unlike in the 70/80 GHz bands, for which there are already hundreds of nationwide licensees, the Commission has only authorized co-primary, non-federal use of the Lower 37 GHz

^{17/} See Report and Order ¶¶ 113-115, 138-151.

^{18/} See Further Notice ¶¶ 448-459.

band. The Commission should therefore permit the greatest degree of innovation possible for the spectrum by designating the band completely for unlicensed use.

The Commission must also make clear that unlicensed devices operating in the Lower 37 GHz band are not required to be operable across all frequencies in the full 37-40 GHz band. Requiring operability beyond the 600 megahertz in the Lower 37 GHz band would unnecessarily complicate device design, deterring investment and innovation in developing unlicensed applications for the band. The marketplace has fostered the development of today's mobile wireless devices that incorporate both licensed and unlicensed spectrum. The Commission should permit the marketplace to make the same decisions with respect to the Lower 37 GHz band.

VI. THE COMMISSION SHOULD AUTHORIZE PART 15 UNLICENSED OPERATIONS IN THE 57-71 GHz BAND ON BOARD AIRCRAFT

Finally, the Commission seeks additional information regarding the coexistence of radio astronomy observation signals and unlicensed devices on board aircraft.^{19/} Wi-Fi Alliance continues to support permitting unlicensed use of the whole 57-71 GHz band on board aircraft. However, to the extent that the Commission continues to be concerned that there will be harmful interference from WiGig devices to radio astronomy observations, the Commission should take a two-step approach.

First, it should remove the prohibition against unlicensed operations on WiGig Channels 2 and 3 (*i.e.*, 59.4-63.72 GHz) on board aircraft. Limiting the use of the 57-71 GHz band on board aircraft to WiGig channels 2 and 3 will address Zodiac Inflight Innovations' concerns regarding the rapid drop-off of interference margin toward the top of the 57-64 GHz band as

^{19/} *Id.* ¶¶ 514-516.

atmospheric attenuation falls above the oxygen absorption peak.^{20/} Eliminating transmissions at the top of the band strikes a balance between Wi-Fi Alliance's earlier concerns that use of the upper WiGig channels would cause harmful interference to Earth Exploration Satellite Service ("EESS") and Radio Astronomy Service operations.^{21/}

Excluding WiGig channel 1 will also address the Committee on Radio Frequencies ("CORF")'s primary concern regarding potential interference from WiGig operations to EESS remote sensing at 57.0-59.3GHz.^{22/} In order to prevent the use of WiGig channels 1, 4, 5 and 6 on board aircraft, WiGig-enabled access points installed on planes could be set to disable those channels. In addition, WiGig-enabled devices could be equipped with a special "airplane mode" function that would prevent any communications, including peer-to-peer communication on WiGig channels 1,4, 5, and 6 while in flight. These solutions, proposed by CORF, will address the issues raised by CORF, the IEEE Committee on Frequency Allocations in Remote Sensing, and the Commission.^{23/}

Second, the Commission and industry should continue to conduct analyses and peer studies on the use of WiGig channels 1, 4, 5, and 6. Wi-Fi Alliance is interested in contributing to those sharing studies to address coexistence concerns on the remaining channels.

^{20/} See Comments of Zodiac Inflight Innovations, GN Docket No. 14-177, *et al.*, at 10-11 (filed Feb. 24, 2016).

^{21/} See Report and Order ¶ 331.

^{22/} See Comments of the National Academy of Sciences' Committee on Radio Frequencies, GN Docket No. 14-177, *et al.*, at 11-16 (filed Jan. 21, 2016). See also Comments of the IEEE Geoscience and Remote Sensing Society Technical Committee on Frequency Allocations in Remote Sensing, GN Docket No. 14-177, at 5-7 (filed Feb. 26, 2016).

^{23/} See Report and Order ¶¶ 329, 330.

VII. CONCLUSION

Wi-Fi Alliance commends the Commission for its earlier actions in this proceeding making additional spectrum available for unlicensed devices. In this next phase of the proceeding, the Commission should continue its efforts to ensure that unlicensed spectrum is available for different kinds of applications requiring different kinds of spectrum. In particular, the Commission should designate spectrum for unlicensed use between 24 GHz and 57 GHz, and above 95 GHz; retain its current, successful approach to management of the 70/80 GHz bands; permit and encourage unlicensed use of the Lower 37 GHz band; and authorize unlicensed operations on WiGig channels 2 and 3 in the 57-71 GHz band on board aircraft.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'Edgar Figueroa', with a long horizontal flourish extending to the right.

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